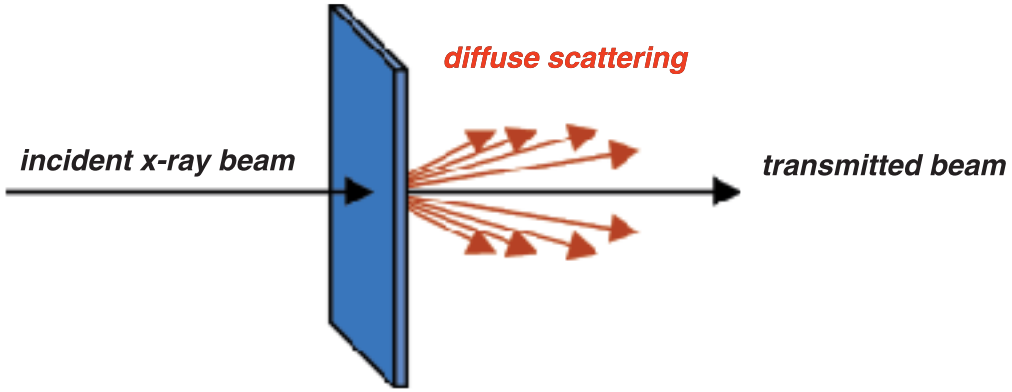
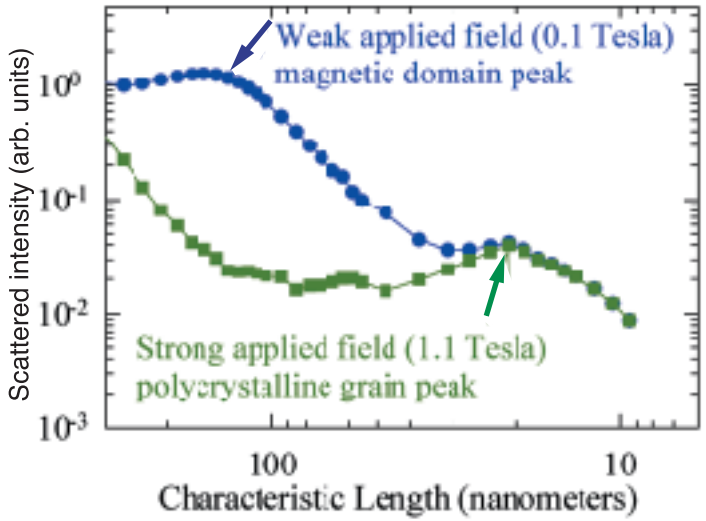
Soft x-ray Resonant Scattering Resolves Nanoscale Magnetic and Chemical Heterogeneity

X-ray Scattering Geometry

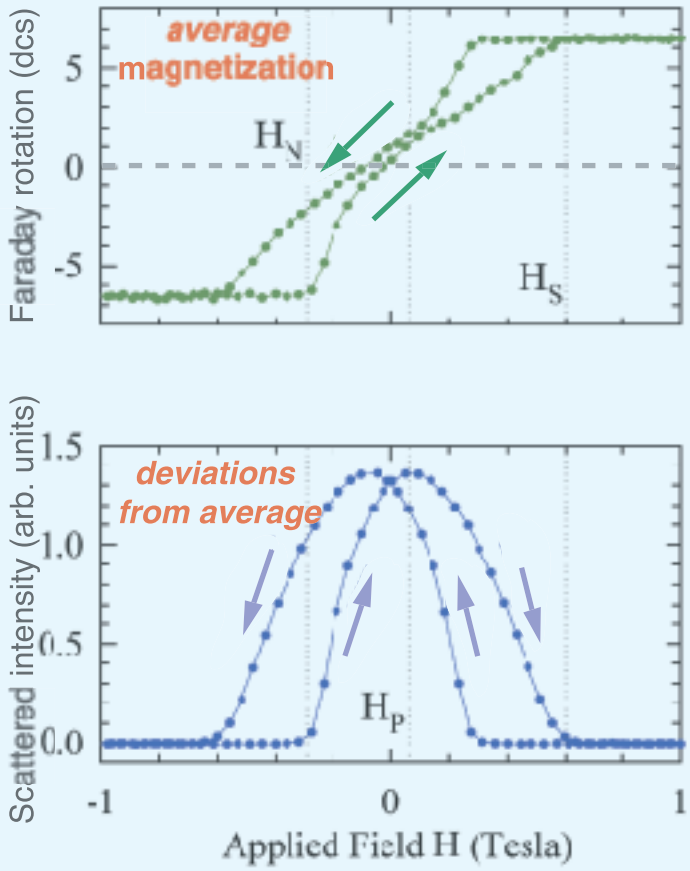


X-ray beam tuned to interact preferentially with magnetic Co atoms in a Co/Pt thin film is scattered by magnetic and chemical spatial variations. The distance scale of the spatial variations can be determined from analysis of the scattering pattern.



In a strong magnetic field (green), an x-ray scattering peak is observed with characteristic length scale of 20 nm that results from chemical structure in the form of polycrystalline grains in the sample. In a weak magnetic field (blue) a new peak appears that results from magnetic domains with characteristic length of over 100 nm that form during the reversal of the sample's magnetization. This ability to simultaneously resolve magnetic and chemical structure is an important feature of this new resonant x-ray scattering technique.

Two Views of Magnetization Reversal—



*The well-known Faraday rotation of the transmitted beam (top) yields the **average** magnetization through the hysteresis cycle. Diffuse scattering at specific angles (bottom) shows how **deviations from average** magnetization evolve at specific characteristic lengths. The scattering signal rises to a maximum near where the average magnetization is zero, demonstrating the value of the new scattering technique to directly measure the size scales of magnetic domains during the reversal process.*

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